X. *A description of the Superior Wing of the* Hymenoptera, *with a view to giving a simpler and more certain Nomenclature to the Alary System of Jurine.* By Claude Morley, F.Z.S.

[Read June 2nd, 1909.]

It is with the hope of introducing something approaching uniformity into the very diversified names at present in use for the various wing cells and nervures of *Hymenoptera* that I lay this paper before the Society.* The front wing alone is dealt with, since the lack of uniformity in the hind one renders any attempt to generalize upon its nervures unprofitable. It was mainly on two accounts that I have been led to study the subject—first, because I had myself committed (*loc. cit. post*) such egregious errors of nomenclature that they cried for redress; and second, because so much attention is now, at length, being accorded the Order that the psychological moment for attempting uniformity appears to have arrived.

Respecting the origin of the neuration, it is quite impossible to say anything of the least exact value. I had hoped to have discovered something to this purpose by an examination of the Order's palaeontology, but am satisfied that nothing is to be deduced therefrom.† Nor is it at all

* My intimate friend, Mr. Ernest A. Elliott, F.Z.S., F.E.S., upon looking through the MS., writes to me: "You start with a 'hope of introducing uniformity,' and it is to be supposed that you want every one to use the terms proposed by you, or rather to accept your statement that this cell or that nervure is so-and-so, but no attempt is made to show why this set of names is better than any other, or more appropriate." This is most fair criticism; but I do not claim this set of names to be better or more appropriate than any other: I choose them purely for their simplicity, and all I aim at is uniformity in their adoption.

† Dr. Heer has described a single small wing from the Lias of the Swiss Alps as "Hymenopterous," but it more probably belonged to some other Order of insects, since no others have been discovered therein, even in localities where *Neuroptera*, etc., have occurred in plenty. The first authentic remains are in the Mesozoic Upper Oolite, whence five distinct species are recorded, three of which are referred to the genus *Apiaria* and one, doubtfully, to *Bombus*.

The chalk yields nothing; but in the Middle Eocene leaf-beds of

evident which families are to be regarded as of the oldest and most recent creation or development, unless we adopt the (to me inconsequent) theory that those of few species and aberrant conformation be such, in which case the

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Bournemouth some (apparently undescribed) *Hymenoptera* remains were found in the seventies.

It is, however, in the Upper Eocene—in the days when mammals first began to become the dominant animals, though long before man's creation—that we find fossils in any numbers. A collection of thirty-five wings was discovered at Gurnard Bay in the Isle of Wight, and of these Frederick Smith (Proc. Geol. Soc. Lond., Dec. 19, 1877) referred "the great majority" to the recent genera *Myrmica* and *Formica*. From strata of the same period near Aix, in Provence, eleven genera of *Hymenoptera*, representing such diverse families as the *Tenthredinidae*, *Ichneumonidae*, *Chalcididae*, *Formicidae*, and *Vespidae* were taken in 1829.

The Lower Miocene has produced only a single species of *Vespidae* from Switzerland, with *Apidae* and *Formicidae* from Rhenish Prussia. *Hymenoptera* began to take their rank as the most prolific Order in the Middle Miocene, whence, in the marls of Croatia, eighty-five species have been described by Heer, of which number fifty-seven appertain to the *Formicidae*, twenty-two to the *Ichneumonidae* (always, doubtless, *sensu latissimo*), and the remainder to the *Vespidae*, *Apidae*, and *Sphegidae*. The lacustrine Upper Miocene of Oeningen also has furnished eighty species (though this time against 508 beetles and 133 *Hemiptera*), with the "great majority" resting among the *Ichneumonidae*, *Formicidae* and *Apidae*. From the Tertiary strata of North America, Scudder has described *Ichneumonidae*, *Chalcididae*, *Formicidae* and *Myrmicidae*; and Heer, from the fragmentary Spitzbergen fossils, has brought forward two other species, *Hymenopterites deperditus* and *Myrmicium boreale*.

It is disappointing to find no *Hymenoptera* whatever in the Pleistocene beds, since these, like so many of the contemporary beetles, might be expected to represent forms still familiar to us; but elytra of Coleoptera will survive where the delicate tissues of bees and ichneumons comminute in such unstable deposits as boulder clay and brick earth.

Thus we see that after two groups of *Aculeata* comes an influx of most of the primary forms existing to-day and representing the three great sections—*Phytophaga*, *Entomophaga* and *Aculeata*. Then *Aculeata*, again, mingling in the superior Miocene with only *Ichneumonidae*, though Tertiary *Chalcididae* occur in America. When we consider the periods of time of these formations and the utter inadequacy of our knowledge, it is very plain that no reliable conclusions are to be drawn therefrom; and this is conclusively illustrated by the sudden appearance of all the main groups together *en bloc*, arguing long antecedent periods through which they had "evolved" into so similar a state to their present form that their families and often genera could thus be assigned. The *Hymenoptera* and *Lepidoptera* are usually regarded as the "youngest," *i. e.* most recently "evolved," Orders of insects; but I believe this to be simply owing to the destructible nature of their tegument.

*Evaniidae*, as regarded by Mr. Bradley, would doubtless form one of the archaic types.

In the following catalogue of the wing cells and nervures I have attempted to synonymize the names applied to the various divisions by all the authors with whom I am myself familiar, and I will at once say that my sole object has been to arrive at a simple system, which is equally applicable to all sections of the Order. That I have neglected the works of many authors upon *Aculeata* and *Tenthredinidae* I am fully aware, and my excuse is that I am entirely persuaded that the simple venational structure was, as one would in the nature of things expect to be the case, the earliest form, and that from which the complex neuration of the sawflies on the one hand and bees on the other have sprung. Jurine attempted to bring the whole Order into line by tracing the venational development from his *Psilus* (nec *Galesus*, Curtis), through *Chalcis*, *Codrus*, *Omalus*, and the Aculeates, up to *Hylotoma*, of which "the wing is filled with its greatest complement of areolets." I am of opinion we shall arrive at a more natural system by tracing two branches, or better three, for the links with the sawflies appear quite lost, and these correspond peculiarly exactly with the *Entomophaga* (excluding *Phytophaga*) and *Aculeata* of Westwood, or, as modern authors are pleased to term them, *Ichneumonidea* and *Vespoidea*.

My conception of the ancestral wing of all *Hymenoptera* is a compound of those of *Bracon* and *Phygadeuon*. A comparison of these will reveal the actual conformity of their structure, though the nervures are so differently disposed that at first sight they appear entirely distinct. In the former, venation is entirely obsolete on the disc, failing to connect the cubital cells, *inter se*, in any way; and, in common with all Braconids, the second recurrent nervure is wanting. In the latter it is again the cubital nervure which is deficient, but this time at its base; it is continuous with the first recurrent nervure, its point of origin being indicated by the "nervelet" or "ramellus" only. This combination will give us the following neuration, traceable more or less in its entirety throughout the Order, as will be seen by the preceding wings, which are numbered in conformity with the following diagram. Additional nervures occur in the *Tenthredinidae*, and the number of cubital cells is multiplied in the *Aculeata*, of

which Shuckard regarded *Gorytes mystaceus* as possessing the most perfect type of Hymenopterous neuration.

From the diagram it will be seen that there are three BASAL cells, besides the PARASTIGMA, so rarely

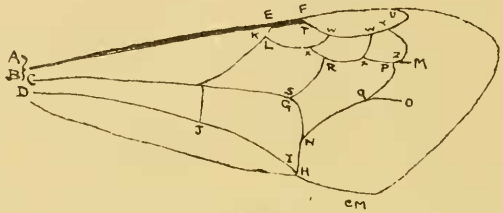


FIG. 1.—*Bombus terrestris*, Linn. (ACULEATA).

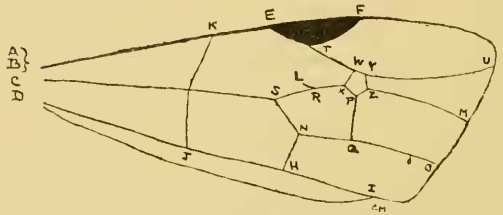


FIG. 2.—*Phygadevon scoticus*, Marsh (ENTOMOPHAGA).

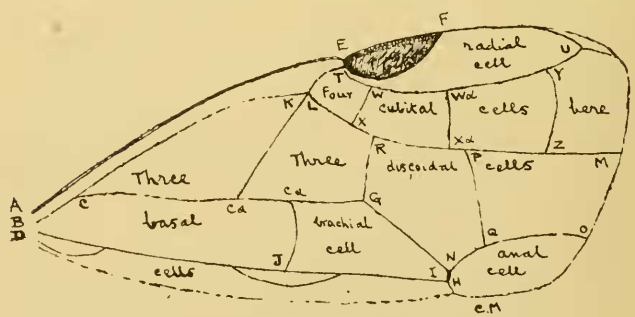


FIG. 3.—*Hylotoma ustulata*, Linn. (PHYTOPHAGA).

referred to in descriptions, though well developed in the phytophagous group, and, as remarked by Jurine, in Chalcis. The STIGMA is always a conspicuous object, never corneous in other Orders, and but feebly developed in the Neuroptera. The RADIAL cell is one of the most con-

stant. Lastly we come to the variable group of cells constituting Kirby and Spence's area intermedia, of which the areolae mediae vary in shape and constancy much more than the areolae apicales, though the latter are often pellucid or wanting. Here are three distinct longitudinal series of cells: those immediately beneath the radial are the CUBITAL and vary in number; beneath them are the DISCOIDAL; and approximating the inner margin of the wing are the ANAL at the apex and the BRACHIAL on its basal side. I have been at some trouble to satisfy myself upon the true relationship of the brachial cell; usually it has been considered to constitute one of the discoidal cells; but I am strongly of opinion that it belongs to the area basalis rather than to the area intermedia; in any case it

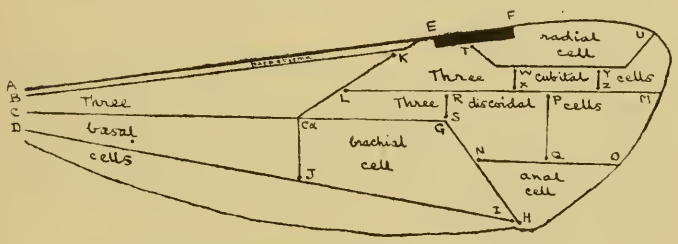


FIG. 4.—Diagrammatic Wing.

must not be commingled with the discoidal, but stand alone, in which case Thomson's name becomes most appropriate.

These cells are constituted by the intersection of the wing tissues by sustaining "nervures," in reality true circulatory veins. The front margin of the wing is always bounded by a strong sustaining COSTA, which may or may not be united with an adjacent and parallel POSTCOSTA. The corneous STIGMA is a strong muscle to sustain the more slender veins and assist in folding the wing. From some part of it the RADIUS runs in a curve to or near the apex of the wing. From the base two other elongate nervures extend to beyond the centre of the wing; the POSTICUS simply sustains the whole lower margin to the sinus, but the MEDIUS is the central nervure and usually goes direct to my point G; beyond this it has usually been regarded as distinct under the name of discoidal vein, etc., but I find that in the very great majority of cases it is

undoubtedly entire. Through the centre of the medius runs a transverse nervure, termed the BASALIS, which is not always continuous, but sometimes coalescent for a greater or less distance with the medius. From the supra-basal a nervure runs more or less straightly to the external margin of the wing in a direction somewhat parallel with the radius; this is the CUBITUS, and it is attached to the radius by one or more transverse nervures, termed the INTERCUBITI, since they divide up the cubital cell into two or more sections. Parallel with the cubitus and below it is the ANALIS, also extending to the outer margin, but rising at some point on the externo-medius. Lastly, one or two RECURRENT nervures are seen, of which the first always runs from the point G in the medius to some point on the cubitus, and the second, when present, from some point on the analis to the cubitus further from the base than the first.

Thus we find but nine main nervures and two series of transverse (the intercubiti and recurrenti) in a typical wing. It is, consequently, remarkable to what extent these have been renamed by the various authors, and gives one some idea of the chaos from which the law of priority—unfortunately inapplicable here—has saved zoological nomenclature.

## SYNONYMIC CATALOGUE OF TERMS.

COSTA (A–E).
- Le bord externe, Jur.
- Costa, Latr. et auctt.
- Nervus costalis, Fall., Dahlb.
- Bord extérieur, Lep.
- Neura costalis, K. & S.
- Margo anticus, radius, Gr.
- 1re nervure humérale, Wesm.
- Radius supérieur, Lep.
- vorderrand, Först.

POSTCOSTA (B–E).
- cubitus, Jur.
- Postcosta, Latr., Thoms.
- Nervus auxillaris, Fall.
- Neura postcostalis, K. & S.
- Cubitus supérieur, Lep.
- Subcostal nervure, Cam.
- Postcostal nervure, Saund.

STIGMA (E–F).
- Le point ou carpe, Jur.
- Punctum costale, Fall.
- Stigma, Grav.
- Stigmate, Wesm.
- Le point épais, Lep.
- Randmal, Först.

RADIUS (T–U).
- Radius, Lep., Wesm., etc.
- Radialader, Först.
- Nervus marginalis, Thoms.
- Radial nervure, Marsh.
- Marginal nervure, Saund.

POSTICUS (D–I).
- Neura analis, K. & S.
- 3me nervure humérale, Wesm.

2nde nervure intermédiaire, Lep.
Hinterader or vena postica, Först.
Brachium, Thoms., Schm.
Accessory nervure, Cam.
Pobrachial nervure, Marsh.
Anal nervure, Marsh., Shuck.
Posterior nervure, Saund., Morl.
Brachius et humerus, Morice.
Submedian or anal, Kief.
Anal vein, Bradley.

Medius (C–G–I).

C–Ca. Nervure brachiale, Jur.
Nervus internus, Latr.
Cubitus, K. & S.
Nervus radians, Dahlb.
2nde nervure humérale, Wesm.
1re nervure intermédiaire, Lep.
Mittalader, vena media, Först.

C–G. Median, Berth., Morl.
Cubitus, Thoms., Schm.
Median nervure, Cam., Kief.
Praebrachial, Marsh.
Medius, Morice.
Externo-medial, Bradley.

G–I. Humeralquerader, Först.
N. recurrens interior, Thoms.
Median nervure, Cam., Schm.
Anal nerve, Morice.
First recurrent, Morl.
First discoidal, Kief.

Ca–I. Discoidal vein, Bradley.
Discoidal nervure, Shuck.

Basalis (J–K).

Basal nervure, Saund., Morl.

J–Ca. Nervus connectens, Dahlb.
Die 1 humeralquerader, Först.
N. transversus ordinarius, Thoms.
Pobrachial transverse, Marsh.
Medio-discoidal, Marsh.
Areal nerve, Morice.
Transverse median, Kief.
Nervulus, Schm.
Transverse median, Bradley.

Ca–K. Grundader, vena basalis, Först.
Vena basalis, Thoms.
Praebrachial transverse, Marsh.
Margino-discoidal, Marsh.
Discoidal nerve, Morice.
Basal nervure, Kief.
Nervus basalis, Schm.
Externo-medial (part), Shuck.
Basal vein, Bradley.

Cubitus (L–M).

Cubitus, Lep., Wesm., Bradley, etc.
Cubitus inférieur, Lep.
Cubital nervure, Shuck., Cam.
Cubitalader, Först.
1sto. nervus spurius, Thoms., Schm.

Intercubiti (W–X ; Y–Z).
Nervi transversi, Fall.
Nervus connectens, Dahlb.
Transverso-cubital n., Shuck., Kief.
Transverse cubital n., Marsh.
Intercubital transverse, Marsh.
Submarginal nervures, Saund., Morl.
Cubital nerves, Morice.
Transverse cubitus, Bradley.

Analis (N–O).
Nervure parallele, Wesm.
Subdiscoidal nervure, Shuck.
Mittalader (part), Först.
2o. nervus spurius, Thoms.
Second recurrent (part), Cam.
Anal nervure, Marsh., Morl.
Posterior nervure, Marsh.
Medius (apex of), Morice.
Discoidal nervure, Kief.
Nervus parallelus, Schm.
Subdiscoidal vein, Bradley.

Recurrentes (R–S ; P–Q).
Nervures recurrentes, Jur.
Anastomoses medii alae, Latr.
Nervi recurrentes, Dahlb.
Recurrent nervures, Shuck., Cam., etc.
Disco-cubitalader und Die 2 discoidalquerader, Först.
Ramellus super. cubiti et N. recurrens exterior, Thoms.
Interior discoidal, Marsh.
Medial nerves, Morice.
Internal cubital and Second recurrent, Morl.
Transverso-discoidal, Kief.
Nervus discoidalis et N. recurrens secundus, Schm.
Recurrent veins, Bradley.

The principal authors upon Hymenopterous Neuration are: (1) *Jurine*—Nouvelle Méthode de Classer les Hyménoptères, 1807 (*cf.* also his Observations sur les ailes des Hyménoptères, in the Mém. Ac. Turin, 1820, p. 117); (2) *Latreille*—Genera Crustaceorum et Insectorum, iv, 1807; (3) *Fallen*—Specimen novam Hymenoptera disponendi methodum exhibens, 1813; (4) *Lepelctier de St. Fargeau*—Encyclop. Méthodique, v, 10, 45 (partie Insectes, 1825); and in his Histoire Naturelle des Insectes Hyménoptères, 1836; (5) *Kirby and Spence*—Introduction to Entomology, vol. iv, 1826; (6) *Gravenhorst*—Ichneumonologia Europaea, 1829; (7) *Necs von Esenbeck* — Monographia Hymenopterorum, 1834; (8) *Dahlbom*—Exercitationes Hymenopterologicae, 1831; (9) *Wesmael*—Monographie Braconides de Belgique, in Nouv. Mém. Ac. Bruxelles, 1835–38; (10) *Shuckard*—A Description of the Superior Wing of the Hymenoptera, with a view to give a fuller and more certain Development to the Alary System of Jurine, in the Trans. Ent. Soc. 1836, pp. 208–14; (11) *Förster*—Monographie der Gattung Campoplex Grav., in the Verh. z.-b. Ges. Wien, 1868, p.

874 (*cf.* also his Ueber den systematischen Werth des Flügelgeäders bei den Insekten und insbesondere bei den Hymenopteren, in Programm der Realschule J. O. zu Aachen für 1876–77); (12) *Thomson*—Opuscula Entomologia, v, 1873, p. 455, etc.; (13) *Cameron*—British Phytophagous Hymenoptera, 1882; (14) *Marshall*—Monograph of Brit. Braconidae, in Trans. Ent. Soc. 1885 [N.B.—The Horismology in this fine work is based on Halliday's somewhat intricate Tabula Orismologica alarum ad Ichneumonidas imprimis applicata (Ent. Mag. 1838, p. 209), wherein are synonymized the terms used by Nees, Lacordaire, Jurine, Lepeletier and his own earlier papers; Bridgman and Fitch have also attempted to utilize these terms when dealing with the Ichneumonidae (sensu stricto) in Entom. 1880, p. 29]; (15) *Marshall*—André's Braconides d'Europe, 1888; (16) *Saunders*—Hym. Aculeata of the Brit. Isles, 1896; (17) *Morice*—Konow's Nomenclature for the Tenthredinidae, in Ent. Month. Mag. 1903, p. 47; (18) *Morley*—Ichneumonologia Britannica, vol. i, 1903; (19) *Kieffer*—André's Proctotrypidae d'Europe, 1904 (*cf.* also André, Spp. des Hym. d'Europe et d'Algérie, etc., vol. i, 1879, p. lxii, *et seqq.*); (20) *Schmiedeknecht*—Die Hymenopteren Mitteleuropas, 1907, p. 542 (*cf.* also Mayr's Formicina Austriaca, in Verh. z.-b. Ges. 1855, p. 273; and Ernst Adolph's Ueber Insectenflügel and Zur Morphologie der Hymenopterenflügel, in Nova Acta Leop Akad., 1870, p. 231; 1879, p. 293; and 1883, p. 41); (21) *Bradley*—On Evaniidae, in Trans. Amer. Ent. Soc. 1908, p. 101 (*cf.* also Comstock and Needham's Wings of Insects, in Amer. Nat. 1898 et 1899, and Macgillivray's Study, in Proc. U.S. Nat. Mus. 1906, p. 569; but also *cf.* Woodworth's excellent Wing Veins of Insects, in Californian Univ. Bull. 1906, pp. 1–152).